A Grid Proxy Architecture for Network Resources

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Agenda

• Challenges

• Grid Proxy Architecture for Networks (GPAN)

• Demo

• Summary
Grids and Networks

• **Network is an integral part to Grids**
  – Network resources guarantee Grid resource sharing
  – Networks resource allocation needed to effectively enable distributed virtual organizations (VOs)

• **Networks are heterogeneous in nature**
  – Different kinds of devices and vendors
  – Domain-specific clouds in separate administrative domains
  – Unknown number of network layers and elements in a p2p connection

• **Networks have their own standards and evolution curve, not necessarily grid savvy**
  – Standards and architectures defined in IEEE, IETF, ITU and others
  – Data plane, control plane, and management plane protocols
  – Network services provided for management and control

• For Grids to be successfully deployed across LAN/MAN/WAN, we need a rich 2-way interaction between Grid and Nets
• Networks are unaware of Grid concepts and services
Challenge:

Grid Management of Network Resources

• **Current network services do not match Grid Resource requirements**
  - E.g., reporting resource status into MDS/Index
  - E.g., allocating resources based on GRAM/RSL request

• **Network elements individually may not be able to offer Grid compatible resource services**
  - Limited CPU, memory, embedded system environment
  - Ineffective allocations of element resources when shared by multiple VO’s

• **Grid deployment over legacy and varied networks**
  - Optical, Ethernet, IP, FR, ATM networks do not all offer same resources
  - Legacy network elements cannot be grid enabled
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Grid Proxy Architecture for Network Resources (GPAN)

- Enables Grid Resource Services to take advantage of existing network services
- The GPAN Grid middleware functionality includes:
  - Proxy for accepting Grid resource requirements
  - Provider of information regarding network resource availability/status
  - Co-existence and integration with GRAM2, MDS
  - Support for RSL2 extensions featuring network resource allocation capabilities
  - OGSI-services providing network resource info & dynamic allocation capabilities
  - Abstract view and access to base network services
Grid Resources: general setup

- A Grid VO utilizes grid resources in Campus A-E
- Service Providers (xSP) on MAN/WAN access networks peer together to provide required network services to the Grid VO.
- Index services collects resource information from computing, storage resources in Campus A-E and xSP
- Broker/metascheduler performs resource lookups and allocations of all grid resources for applications
Proxy architecture implements scalable resource services for networks

- **GPAN Grid Service**
  - Provides a GRAM-2 instance in a network
  - Extends RSL2 for network resources
  - Supports resource discovery and info updates on the Grid
  - Supports resource dynamic provisioning, optimization
  - Resource Services such as GRAM talks to GPAN for network resource requests
  - Grid clients and services use GPAN WSDL interface
Resource Management Flow

- MDS
- Broker/Metascheduler
- Application
- GRAM2 Storage RM
- GRAM2 Computing RM
- GRAM2 GPAN
- GRAM2 Visual. RM

Network Service overlay
Network RM

Derived from © ANL Material
• **GPAN provides network info to MDS/Index**
  – Proxy for network resource allocation status and updates
• **Network Info Provider (NIP) aggregates resource discovery and status updates**
  – Based on virtual network topology related to the VO
1) Application requests broker/metascheduler for job services and resources
2) Broker/metascheduler generates RSL2 for resource allocation requests after consulting MDS/Index
3) xSPs co-ordinate to allocate requested resources
GPAN Programming Model

• **Two service infrastructures involved**
  – OGSI: Grid services
  – NS: network services

• **GPAN Service Components**
  – GPS: GPAN proxy
  – NIP: GPAN network info provider
  – GDS: GPAN delegation
  – Smart: NS intelligence
  – NPS: NS network provisioning
  – RIS: NS network discovery and info update

• **Other Service Components**
  – BM: Broker/Metascheduler
  – MJS: Managed Job Service
GPAN RSL2 is defined in terms of XML and schemas

- GPAN RSL2 is used for resource allocation, info and feedback
- GPAN RSL2 is fully extensible
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1. I’m in San Francisco. I need this application of mine to munch on a 200 GB data set. Elapsed time is a known function of Ω/N, with Ω a manifest constant and N the number of processors <= 100. I need the result (estimated ~100 GB) to be shipped to Chicago, Eindhoven, and back here within the next 12 hrs.

2. That is, I *anycast* everything but the final destination(s)

3. Infrastructure decides [A,B,C] vs. [A,B,δ] vs. [A,β,δ] vs.[others] according to which Location [X]s complies and which optical by-passes [A,B,C,β,δ] can be set at times t₀ and t₀+f(Ω /N). Proceed to reserve Location [X] with the chosen optical by-passes (all or none).
“A Globus-based Grid Infrastructure Negotiates Ephemeral Optical Bandwidth Boost”

- Two applications use Grid FTP for communicating large sets of data
- Grid FTP provides data movement requirements and constraints to GPAN
- GPAN Proxy module translates Grid requirements to appropriate network resource allocation
- GPAN Proxy module works with Network provisioning services to allocate optical by-pass as shown.
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Related Work

• **GARA, DUROC**
  – Concept of Resource co-allocation, scheduler, advanced reservations leveraged in our work
  – GPAN extends the reach of GARA/DUROC concepts
  – Job Manager in GPAN refers to GRAM2 and its instances

• **WS-Agreement**
  – Services and resource lifetime-management and policy-based negotiations between network domains

• **GRAM/RSL/JSDL**
  – Extend RSL2 to work with GPAN for network resources
  – JSDL is new standard being discussed @GGF for job submissions
Relevant Standards Activities

• Global Grid Forum

• DMTF
  – CIM schemas for network devices and end-to-end services

• OIF
  – New UNIs

• IETF/IRTF
  – Policy, AAAs

• ITU
  – VPNs, (E)NNIs, GMPLS

• OASIS, W3C
  – Evolution of WS technologies
Summary

• **GPAN leverages existing network service facilities for Grid resource provisioning**
  – Grid applications need not to use or know about network services
  – Current network services need not to be modified for Grids
  – GPAN exploits network smart services for Grid applications
  – No Grid service is deployed on any particular network element

• **GPAN Achievement**
  – Support of OGSI 1.0, GT3 implementation
  – Extensions to RSL2 for network resource info and allocation
  – GT3 integration with MDS/Index
  – Built on Nortel’s extensible network service platform
  – Can run over hybrid optical + IP networks
  – Live demo at GW04!